

Chemical structure of the Hawaiian plume and its 0 - 3 Ma evolution

Ryoji Tanaka[1]; Akio Makishima[2]; Eizo Nakamura[3]

[1] ISEI, Okayama Univ.; [2] ISEI, Okayama Univ.; [3] ISEI(Misasa), Okayama Univ.

<http://www.misasa.okayama-u.ac.jp/>

The Hawaiian hotspot is regarded as one of the best examples of an upwelling mantle plume whose source derives from near the base of the Earth's mantle. Geochemical and petrological data of the Hawaiian lavas, therefore, have been applied to the modeling of the chemical structure of the upwelling plume. The relevant feature of the recent (younger than 5 Ma) Hawaiian shield building lavas, at a large scale, is the existence of double volcanic loci, which are generally referred to as the Kea and Loa trends. In a two-dimensional plane view, the distinct isotopic values between Loa- and Kea-trends have provided evidence of large-scale heterogeneity between the north-eastern and south-western sides of the plume. In this presentation we show that the Sr-Nd-Hf-Pb isotopic data of the shield building lavas along the Loa locus form a systematic trend from the main shield stage of Koolau (older than 2.9 Ma) to the active Loihi volcanoes. During the growth of the Koolau volcano, the dominant material in the melting region successively changed from the proposed KEA, DMK (depleted Makapuu), to EMK (enriched Makapuu) components. The proportion of EMK, dominated by a recycled mafic component, is typified by some Koolau Makapuu-stage and some Lanai lavas. Subsequently, the EMK component decreased and LOIHI component increased toward the Loihi lavas. The temporal coincidence between the episodically elevated magma production rate and the abrupt appearance of the typical Loa-type lavas that is restricted to the last 3 Myr should be linked to magma genesis. We suggest that the abrupt appearance of Loa type magmatism should be attributed to the transient incorporation of the relatively dense recycled material and surrounding less degassed lower mantle material that accumulated near the core-mantle boundary into the upwelling plume. This episodic involvement could have been triggered by episodic thermal pulses and buoyancy increases in the plume. The continuous appearance of Kea-type lavas during the long history of Hawaiian-chain magmatism and the larger magma volume of Kea-type lavas relative to that of the Loa-type lavas in the last 3 Myr indicate that the Kea locus is closer to the thermal centre of the Hawaiian plume relative to that of the Loa locus.